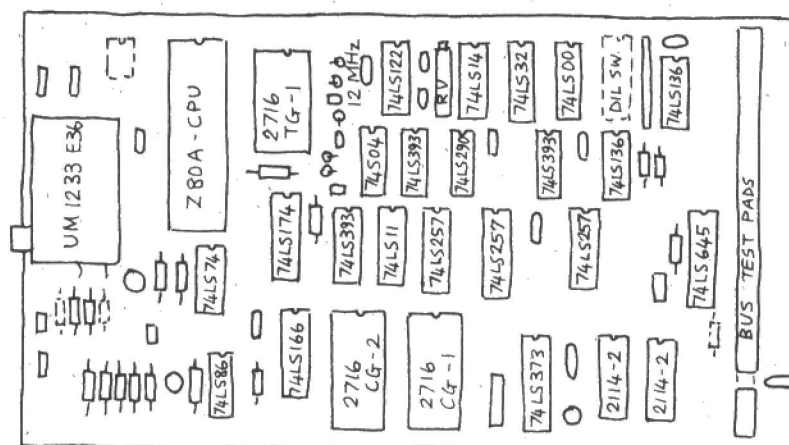


Greenbank Electronics  
Telephone: 051-645 3391

## Interak 1

VDU  
CARD

### Single Card VDU (Television Interface)



### VDU-K Single Card VDU

## FEATURES

- \* International Size Card (4.5" x 8").
- \* 32 characters x 24 lines.
- \* Character cell 8 x 10 dots.
- \* Character set held in EPROM (1 or 2 2716 or 2532/2732).
- \* Up to 256 different characters available, or 128 + 128 inverted.
- \* "No snow" operation - works with Z80A at 4MHz with no wait states.
- \* Uses 200ns RAMs e.g. type 2114L-200.
- \* Single card (replaces earlier VDU-A,B,G).
- \* On board wide-bandwidth Modulator for use with standard TV set.
- \* Low dot rate clock (6 MHz) ensures high quality display on standard TV set.
- \* Direct composite video output for TV Monitor.
- \* Plated-through holes, Epoxy-glass PCB.
- \* Green Solder Resist on "A" side.
- \* Gold-plated edge connector on both A and B sides.
- \* 5V only operation.
- \* Sync. pulses include equalisation pulses.
- \* Line sync. maintained during frame sync. time.
- \* Interlaced/non-interlaced option switch selectable.
- \* Uses dedicated Z80A to generate sync. pulse timing.
- \* Quartz crystal for timing accuracy.
- \* ASCII high-bit invert or alternative character set.
- \* Optional switch for "invert all".
- \* Standard character generator includes upper/lower case, pixel characters, and line drawing characters.
- \* Lower case characters have decenders.
- \* Character cells adjoin for continuous coverage.
- \* Memory Mapped, may be addressed at any 1K boundary.
- \* ISBUS-A, INTERAK 1 bus compatible.
- \* KBUS-5, KBUS-12 compatible.
- \* Buffered where necessary to reduce bus loading to 1 "LS" load per line.
- \* No manufacturer's name appears on the card, thus ideal for OEM use.

## DESCRIPTION

The VDU-K provides a high-quality display on a standard 625-line TV set, via its on-board wide bandwidth UHF modulator, or if desired a composite video signal is independently available to drive a TV monitor. The user can choose to have either black characters on a white background, or white characters on a black background, according to his personal preference.

The VDU-K appears to the computer as 1K of RAM, starting at any chosen 1K boundary, selected by DIL switches. However in fact only the first 0.75K of the VDU RAM is displayable, and the last 0.25K is available to the user (this can be quite useful in a very small system which involves a VDU-K, as there is sometimes no need for a separate RAM card). It should be noted that it is not possible to run programs in the video RAM, the timing restrictions are such that it can only be used as read/write memory.

The 7-bit ASCII code is used as the basis for the character definition, for example a "41" (hexadecimal notation) written to the first location in the VDU RAM would result in a letter "A" being displayed in the top left-hand corner of the VDU screen, "42" would be "B", and so on. As the entire character generator set is held in EPROM, any desired sequence or font of characters can be programmed. The total screen displays as 256 dots across x 240 dots down, so for special applications graphics characters having an equivalent resolution of 61,440 dots per screen can be programmed into the EPROM character generator. Examples of special dedicated applications are chess pieces, and pipes and steam valves etc. to give a very inexpensive "mimic" diagram for process control and the like.

The standard 2716 EPROM pre-programmed character generator provides 128 characters including all of the printable ASCII characters, upper- and lower-case letters, with "descenders" where appropriate. A 5x7 matrix is used for the majority of the characters, and the matrix is placed within the 8x10 character cell so that these inverted video characters do not "fall out" of the cell, and thus remain very readable. The non-printing ASCII characters (carriage-return, line-feed and so on) make up the remainder of the standard 2716 character generator. Line-drawing and "pixel" characters (quarter character squares) are displayed for most of the non-printing codes, and there are a few graphics characters in the remaining space.

If the 7-bit ASCII code is presented to the VDU-K in a byte with the high bit set, the displayed character will appear in inverse video, i.e. black will be white, and vice versa, for that particular character. An alternative option is to let the high bit select a whole new character generator EPROM, containing a further 128 pre-programmed characters, making 256 in all. The extra characters are normally contained in a second 2716 EPROM, but the pair of EPROMs can be replaced if desired by a single type 2532 or 2732.

The second set of characters if used is called the "Applications" character set, as they will depend to what application the VDU-K is being put. For an amusement arcade type of game the Applications EPROM could contain assorted space invaders and the like, whereas for a computer aided circuit design application the EPROM could contain transistor, resistor, logic gate etc. symbols.

Any of the dots in the 8x10 character cell can be programmed into the EPROM character generator, and adjacent cells touch on the screen, so that the character set designer has a fairly free hand.

## No Snow

The outstanding feature of the VDU-K is that there are no restrictions placed on the timing of CPU reads and writes. A Z80A operating at 4 MHz can read from or write to a location on the screen at any time, without causing any disturbance ("snow") whatever on the display. "Wait" states are not required, and in fact are detrimental since they prolong the CPU access long enough to deprive the VDU of its correct data and so cause "snow" on the screen. The CPU can be operated at a lower speed, but the anti-snow feature of the VDU-K will not be so effective.

A television sync. waveform has to be fairly complex if it is to meet the required specification. For example there should be five half line equalising pulses at the beginning and end of each frame, and the line sync. should be kept going during the frame sync. time. It is very rare even for modern computers to comply with these latter requirement; most often they discontinue the line pulses during the frame sync. time, and hope that the good natured television set line timebase can regain line synchronisation in time to avoid spoiling the display. If you look at the top few lines of the television output of many computers you will see what a forlorn hope this is, as there is often visible "pulling" at the top of the display.

As a television set has a fairly short persistence phosphor, better results are often obtained by choosing a "non-interlaced" display, since this refreshes individual picture elements at a 50 Hz rate rather than the 25 Hz rate of a fully interlaced display. Particularly when viewed from a metre or less, there is much reduced flicker with a non-interlaced display. The VDU-K has a switch setting so that the user can select whichever he prefers.

## Unique Sync. Circuit

The necessary complication of the sync. waveform circuit has been satisfied in a unique manner on the VDU-K. Instead of the several LS TTL packages that would have been required to generate the proper "no compromises" interlaced/non-interlaced sync. timing, a dedicated Z80A has been used. Although no work has been carried out on this question, it is possible that it would be fairly easy to modify the control program to suit other TV standards, e.g. 525 lines instead of 625.

Because of the good number of internal registers in the Z80A, no external RAM is needed in this application, and it turns out that the use of the Z80A for sync. generation uses less space than the alternative solutions, and as a bonus is cheaper.

## Sensible Screen Format

The number of characters across the screen is limited by the bandwidth of the television receiver. The number chosen (32) was selected for several reasons: to be compatible with earlier systems (e.g. VDU-A,B,G), and to enable much of the software for the Sinclair ZX-81 (which uses the same format) to be converted easily by users. The number 32 is the round figure "20" in hexadecimal, which makes the task of handling fast motion on the screen (one of the main applications of a "no snow" VDU) much easier to program. With a fairly large character cell like this a sizeable character block results if adjacent cells are joined together. This makes games such as "Space Invaders" much more enjoyable than if they are played with very small, cramped characters. Also the good size character is very legible

especially at a distance, for example if displaying announcements (e.g. airport announcements, betting shop results etc.) on a television set. The final benefit attached to the number of characters chosen is the fact that the character cell is near enough square. Apart from improving legibility of alphanumeric characters, this means that 45 degree lines plotted using the pixel characters are very close to the correct angle, and a circle is very close indeed to being circular. (Unless you are experienced with computers you will be quite surprised to find how many circles plotted on even quite expensive machines are not circular at all.)

### Easy Construction

All of the components used are readily available, and the 27 integrated circuits used are all laid out the same way round, which makes the card very straightforward to construct and test. Wherever possible signal tracks which have to pass between the legs of ICs are taken on the A-side so that they can be inspected in case of trouble. (Less considerate designers take them on the B-side where any shorts will be hidden under the IC sockets!) Plated-through hole construction is provided, and a solder resist mask on the A-side.

Although all of the signals are taken via the A-side of the edge connector (which is gold-plated) and a gold-plated edge connector is also provided on the B-side.

### CONTENTS OF KIT

The kit of components, which is sold separately from the p.c.b. itself, includes 18 resistors, 1 SIL resistor pack, 1 variable resistor, 17 capacitors, 2 diodes, 1 transistor, 1 12.0 MHz crystal, 26 integrated circuits (including the standard character generator, and sync. pulse generator), 1 8xSPST DIL switch, 28 integrated circuit sockets (including sockets for the DIL switch and 2nd character generator), and some wiring pins. A 1" metal card front and some connectors and option switches are recommended but are not included in the kit to keep the basic cost down for those working to limited budgets. Also note that the wide bandwidth modulator (Type UM1233 E36) should be purchased separately. It has not been included because an increasing number of users now have Video Monitors, and/or can salvage a modulator from a disused computer, e.g. ZX-80.

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